smartprocess
control & instrumentation

User Manual

2014 v3.0

SMARTRAIL X835-MID

MID DIN Rail Smart Energy Meter for Single and Three Phase Electrical Systems

1 Introduction

This document provides operating, maintenance and installation instructions. This unit measures and displays the characteristics of single phase two wires (1p2w), three phase three wires (3p3w,) and three phase four wires (3p4w) networks. The measuring parameters include voltage (V), frequency (Hz), current (A), power (kW/Kva/Kvar), Imported, exported and total Energy (kWh/kvArh). The unit also measures Maximum demand current and power, this is measured over preset periods of up to 60 minutes.

This unit is a 1A or 5A current transformer operated and can be configured to work with a wide range of CTs. Built-in pulse and RS485 Modbus RTU outputs. Configuration is password protected.

This unit can be powered from a separate auxiliary (AC or DC) supply. Alternatively it can be powered from the monitored supply by linking the voltage reference and neutral reference in to terminals 5 + 6 (Please refer to wiring diagram).

1.1 Unit Characteristics

The Unit can measure and display:

- Line voltage and THD% (total harmonic distortion) of all phases
- Line frequency
- Currents, current demands and current THD% of all phases
- Power, maximum power demand and power factor
- Active energy imported and exported
- Reactive energy imported and exported

The unit has password protected set-up screens for:

- Changing password
- Supply system selection 1p2w, 3p3w,3p4w
- Demand interval time
- Reset for demand measurements
- Pulse output duration

1.2 Current Transformer Primary Current

This unit has to be configured to operate with a CT, The optional secondary currents or 1A or 5A. it is programmed by inputting the ratio (Please see section 4.5).It can be used on primary currents up to 6000A.

Please also be aware on the MID version you can only program the ratio once.

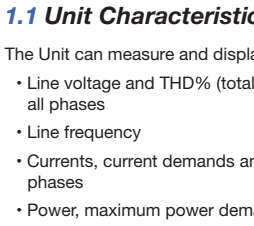
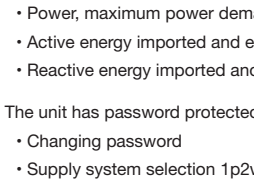
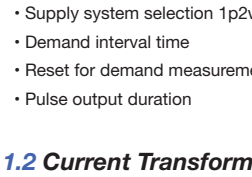
1.3 RS485 Serial – Modbus RTU

RS485 serial port with Modbus RTU protocol to provide a means of remotely monitoring and controlling the Unit. Set-up screens are provided for setting up the RS485 port. Refers to section 4.8.

1.4 Pulse output

Two pulsed outputs that can be set for active(kWh) or reactive (kVArh) energy. Terminals 11 & 12 have a fixed output of 3200imp/kWh. The settable pulse output is terminals 9 & 10.

2 Start Up Screens

	The first screen lights up all display segments and can be used as a display check.
	The second screen indicates the firmware installed in the unit and its build number.
	The interface performs a self-test and indicates the result if the test passes.

*After a short delay, the screen will display active energy measurements.

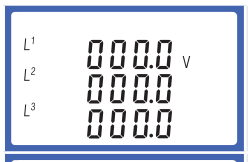
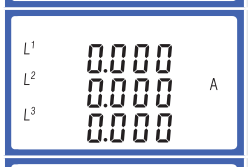
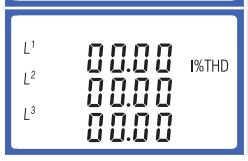
3 Measurements

The buttons operate as follows:

U/I ESC	Selects the Voltage and Current display screens. In Set-up Mode, this is the “Left” or “Back” button.
M	Select the Frequency and Power factor display screens. In Set-up Mode, this is the “Up” button.
P	Select the Power display screens. In Set-up Mode, this is the “Down” button.
E	Select the Energy display screens. In Set-up mode, this is the “Enter” or “Right” button.

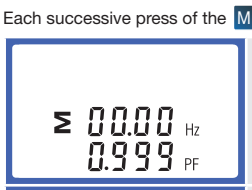
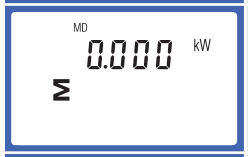
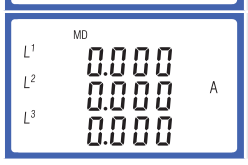
3.1 Voltage and Current

Each successive press of the U/I button selects a new parameter:

	Phase to neutral voltages.
	Current on each phase.
	Phase to neutral voltage THD%.
	Current THD% for each phase.

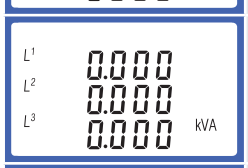
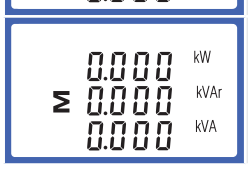
3.2 Frequency and Power Factor and Demand

Each successive press of the M button selects a new range:

	Frequency and Power Factor (total).
	Power Factor of each phase.
	Maximum Power Demand.
	Maximum Current Demand.

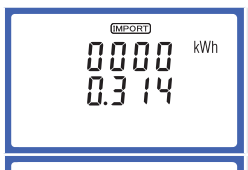
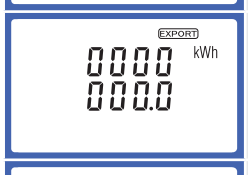
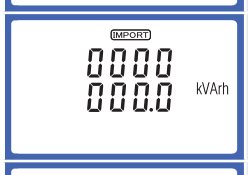
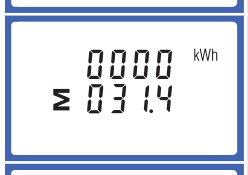
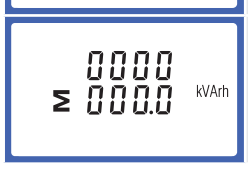
3.3 Power

Each successive press of the P button select a new range:

	Instantaneous Active Power in kW.
	Instantaneous Reactive Power in kVAr.
	Instantaneous Volt-Amps in KVA.
	Total kW, kVArh, kVA.

3.4 Energy Measurements

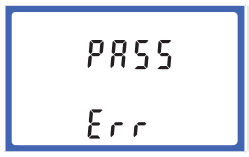
Each successive press of the E button selects a new range:

	Imported active energy in kWh.
	Exported active energy in kWh.
	Imported reactive energy in kVArh.
	Exported reactive energy in kVArh.
	Total active energy in kWh.
	Total reactive energy in kVArh.

Please note the register is 9999999.9 display over two lines.

4 Set Up

To enter set-up mode, press the E button for 3 seconds, until the password screen appears.

	Setting up is password-protected so you must enter the correct password (default ‘1000’) before processing.
	If an incorrect password is entered, the display will show: **PASS Err**

To exit setting-up mode, press U/I repeatedly until the measurement screen is restored.

4.1 Set-up Entry Methods

Some menu items, such as password and CT, require a four-digit number entry while others, such as supply system, require selection from a number of menu options.

4.1.1 Menu Option Selection

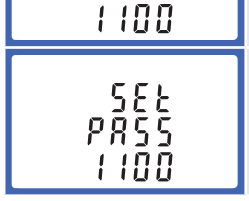
1. Use the M and P buttons to scroll through the different options of the set up menu.
2. Press E to confirm your selection
3. If an item flashes, then it can be adjusted by the M and P buttons.
4. Having selected an option from the current layer, press E to confirm your selection. The SET indicator will appear.
5. Having completed a parameter setting, press U/I to return to a higher menu level. The SET indicator will be removed and you will be able to use the M and P buttons for further menu selection.
6. On completion of all setting-up, press U/I repeatedly until the measurement screen is restored.

4.1.2 Number Entry Procedure

When Setting up the unit, some screens require the entering of a number. In particular, on entry to the setting up section, a password must be entered. Digits are set individually, from left to right. The procedure is as follows:

1. The current digit to be set flashes and then can be adjusted using the M and P buttons
2. Press E to confirm each digit setting. The SET indicator appears after the last digit has been set.
3. After setting the last digit, press U/I to exit the number setting routine. The SET indicator will be removed.

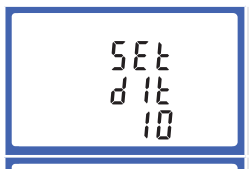
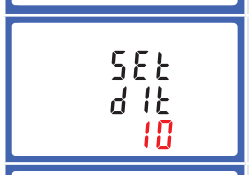
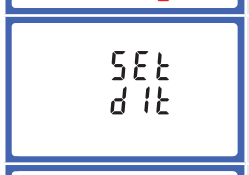
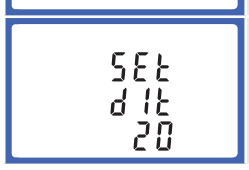
4.2 Change Password

	Use the M and P to choose the change password option.
	Press the E to enter the change password routine. The new password screen will appear with the first digit flashing.
	Use M and P to set the first digit and press E to confirm your selection. The next digit will flash.
	Repeat the procedure for the remaining three digits.
	After setting the last digit, SET will show.

Press U/I to exit the number setting routine and return to the Set-up menu. SET will be removed

4.3 DIT Demand Integration Time

This sets the period in minutes over which the current and power readings are integrated for maximum demand measurement. The options are: off, 5, 10,15 30,60 minutes.

	From the set-up menu, use M and P buttons to select the DIT option. The screen will show the currently selected integration time.
	Press E to enter the selection routine. The current time interval will flash.
	Use M and P buttons to select the time required.
	Press E to confirm the selection. SET indicator will appear.

Press U/I to exit the DIT selection routine and return to the menu.

Warnings

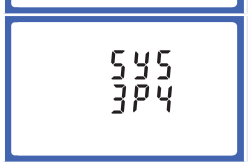
Important Safety Information is contained in the Maintenance section. Familiarize yourself with this information before attempting installation or other procedures. **Symbols used in this document:**

Risk of Danger: These instructions contain important safety information. Read them before starting installation or servicing of the equipment.

Caution: Risk of Electric Shock

4.4 Supply System

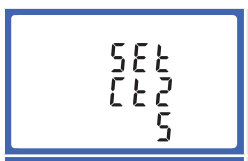
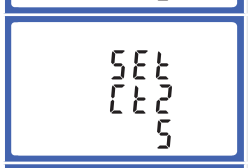
The unit has a default setting of 3Phase 4wire (3P4). Use this section to set the type of electrical system.

	From the set-up menu, use M and P buttons to select the system option. The screen will show the currently selected power supply.
	Press E to enter the selection routine. The current selection will flash.
	Use M and P buttons to select the required system option: 1P2(W),3P3(W) ,3P4(W).
	Press E to confirm the selection. SET indicator will appear.

Press U/I to exit the system selection routine and return to the menu. SET will disappear and you will be returned to the main set-up Menu.

4.5 CT

The CT option sets the secondary current (CT2 1A or 5A) of the current transformer (CT) that wires to the meter.

	From the set-up menu, use M and P buttons to select the CT option.
	**Secondary CT setting** Press E to enter the CT secondary current selection routine.:5A/1A
	Set CT Ratio value Press E to enter the CT Ratio setting screen. The range is from 0001 to 9999.

For example, if using a 100/5A current transformer you will enter 0020, as you need to divide the primary by the secondary to get the ratio (CT rate).
Please note as this is a MID approved device, you will only have one opportunity to set the ratio.

4.6 PT

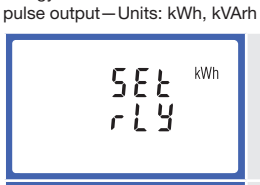
The PT option sets the secondary voltage (PT2 100 to 500V) of the voltage transformer (PT) that may be connected to the meter.

	From the set-up menu, use M and P buttons to select the PT option. The screen will show the voltage PT secondary voltage value. The default value is 400V.
	Secondary PT setting Press E to enter the PT secondary voltage selection routine. The range is from 100 to 500V.
	Set PT ratios value Press E to enter the PT ratio screen. The range is from 0001 to 9999.

For example, if set the ratio to be 100,it means the primary voltage equals secondary voltage x100.

4.7 Pulse Output

This option allows you to configure the pulse output. The output can be set to provide a pulse for a defined amount of energy active or reactive. Use this section to set up the relay pulse output—Units: kWh, kVArh

	From the set-up menu, use M and P buttons to select the Pulse output option.
	Press E to enter the selection routine. The unit symbol will flash.
	Use M and P buttons to choose kWh or kVArh.

On completion of the entry procedure, press E to confirm the setting and press U/I to return to the main set up menu.

4.7.1 Pulse rate

You can configure the pulse output to relate to a defined amount of imported or exported energy. This can also be set to use with active energy (kWh) or reactive energy (kVarh).

Please note there are limitations that need to be factored in when setting the pulsed output. This is based upon the relay output only being able to pulse 2 times in one second.

For example, If the CT is set to 500/5A on a single phase network this would generate (500Ax230V=115,000 / 1000) 115kWh which is 31W per second. A setting of 10imp/kWh (10 pulses per kWH) would generate 3 pulses per second. This will exceed the 2 pulse per second limitation.

Pulse settings: 1 pulse per 0.01(100W) / 0.1(10W) / 1 (1kWh) / 10(10kWh) / 100(100kWh) /1000 (1000kWh)

SEt rAtE 10	From the set-up menu, use M and P buttons to select the Pulse Rate option.
SEt rAtE 10	Press E to enter the selection routine. The current setting will flash. 0.01/0.1/1/10/100kWh/ kVArh per pulse.

Use M and P buttons to choose pulse rate. On completion of the entry procedure, press E to confirm the setting and press U/I to return to the main set up menu.

4.7.2 Pulse Duration

The energy monitored can be active or reactive and the pulse width can be selected as 200, 100 or 60ms.

SEt PULS 200	From the set-up menu, use M and P buttons to select the Pulse width option.
SEt PULS 200	Press E to enter the selection routine. The current setting will flash.

Use M and P buttons to choose pulse width.
On completion of the entry procedure press E to confirm the setting and press U/I to return to the main set up menu.

4.8 Communication

There is a RS485 port can be used for communication using Modbus RTU protocol. For Modbus RTU, parameters are selected from Front panel.

4.8.1 RS485 Address

SEt Addr 001	From the set-up menu, M and P buttons to select the address ID.
SEt Addr 101	Press E button to enter the selection routine. The current setting will be flashing.
SEt Addr 101	Use M and P buttons to choose Modbus address (001 to 247).

On completion of the entry procedure, press E button to confirm the setting and press U/I button to return the main set-up menu.

4.8.2 Baud Rate

SEt bAUd 9.6 k	From the set-up menu, use M and P buttons to select the Baud Rate option.
SEt bAUd 9.6 k	Press E to enter the selection routine. The current setting will flash.
SEt bAUd 38.4 k	Use M and P buttons to choose Baud rate 2.4k. 4.8k, 9.6k, 19.2k, 38.4k

On completion of the entry procedure, press E to confirm the setting and press U/I to return to the main set up menu.

4.8.3 Parity

SEt PArI EuEN	From the set-up menu, use M and P buttons to select the parity option.
SEt PArI EuEN	Press E to enter the selection routine. The current setting will flash.
SEt PArI nONE	Use M and P buttons to choose parity (EVEN / ODD / NONE (default)).

On completion of the entry procedure, press E to confirm the setting and press U/I to return to the main set up menu.

4.8.4 Stop bits

SEt StoP 2	From the set-up menu, use M and P buttons to select the stop bit option.
SEt StoP 2	Press E to enter the selection routine. The current setting will flash.
SEt StoP 1	Use M and P buttons to choose stop bit (2 or 1)

On completion of the entry procedure, press E to confirm the setting and press U/I to return to the main set up menu.

4.9 CLR

The meter provides a function to reset the maximum demand value of current and power.

CLr	From the set-up menu, use M and P buttons to select the reset option.
CLr dIt	Press E to enter the selection routine. The dIt will flash.

Press E to confirm the setting and press U/I to return to the main set up menu.

5 Specifications

5.1 Measured Parameters

The unit can monitor and display the following parameters of a single phase two wire (1p2w), three phase three wire (3p3w) or three phase four wire (3p4w) system.

5.1.1 Voltage and Current

- Phase to neutral voltages 100 to 289V a.c. (not for 3p3w supplies).
- Voltages between phases 173 to 500V a.c. (3p supplies only).
- Percentage total voltage harmonic distortion (THD%) for each phase to N (not for 3p3w supplies).
- Percentage voltage THD% between phases (three phase supplies only).
- Current THD% for each phase

5.1.2 Power factor and Frequency and Max. Demand

- Frequency in Hz
- Instantaneous power:
- Power 0 to 3600 MW
- Reactive power 0 to 3600 MVAr
- Volt-amps 0 to 3600 MVA
- Maximum demanded power since last Demand reset Power factor
- Maximum neutral demand current, since the last Demand reset (for three phase supplies only)

5.1.3 Energy Measurements

• Imported/Exported active energy	0 to 9999999.9 kWh
• Imported/Exported reactive energy	0 to 9999999.9 kVArh
• Total active energy	0 to 9999999.9 kWh
• Total reactive energy	0 to 9999999.9 kVArh

5.2 Measured Inputs

Voltage inputs through 4-way fixed connector with 2.5mm² stranded wire capacity. Single phase two wire(1p2w), three phase three wire(3p3w) or three phase four wire(3p4w) unbalanced. Line frequency measured from L1 voltage or L3 voltage. Three current inputs (six physical terminals) with 2.5mm² stranded wire capacity for connection of external CTs. Nominal rated input current 5A or 1A a.c. Rms.

5.3 Accuracy

• Voltage	0·5% of range maximum
• Current	0·5% of nominal
• Frequency	0·2% of mid-frequency
• Power factor	1% of unity (0.01)
• Active power (W)	±1% of range maximum
• Reactive power (VAr)	±1% of range maximum
• Apparent power (VA)	±1% of range maximum
• Active energy (Wh)	Class 1 IEC 62053-21
• Reactive energy (VARh)	±1% of range maximum
• Total harmonic distortion	1% up to 31st harmonic
• Response time to step input	1s, typical, to >99% of final reading, at 50 Hz.

5.4 Auxiliary Supply

Two-way fixed connector with 2·5mm2 stranded wire capacity. 85 to 275V a.c. 50/60Hz ±10% or 120V to 380V d.c. ±20%. Consumption <2W 10VA.

5.5 Interfaces for External Monitoring

Three interfaces are provided:

- RS485 communication channel that can be programmed for Modbus RTU protocol
- Relay output indicating real-time measured energy. (configurable)
- Pulse output 3200imp/kWh (not configurable)

The Modbus configuration (baud rate etc.) and the pulse relay output assignments (kW/kVArh, import/export etc.) are configured through the set-up screens.

5.5.1 Pulse Output

Opto-coupler with potential free SPST-NO Contact (Contact range 5-27VDC / Max current input: Imin 2mA and Imax 27mA DC). The pulse output can be set to generate pulses to represent kWh or kVArh.

Rate can be set to generate 1 pulse per:
0.01 = 10 Wh/VArh
0.1 = 100 Wh/VArh
1 = 1 kWh/kVArh
10 = 10 kWh/kVArh
100 = 100 kWh/kVArh

Pulse width 200/100/60 ms.

5.5.2 RS485 Output for Modbus RTU

For Modbus RTU, the following RS485 communication parameters can be configured from the set-up menu:

Baud rate 2400, 4800, 9600, 19200, 38400

Parity none (default) / odd / even

Stop bits 1 or 2

RS485 network address nnn – 3-digit number, 1 to 247

Modbus™ Word order Hi/Lo byte order is set automatically to normal or reverse. It cannot be configured from the set-up menu.

5.6 Reference Conditions of Influence Quantities

Influence Quantities are variables that affect measurement errors to a minor degree. Accuracy is verified under nominal value (within the specified tolerance) of these conditions.

• Ambient temperature	23°C ±1°C
• Input waveform	50 or 60Hz ±2%
• Input waveform	Sinusoidal (distortion factor < 0·005)
• Auxiliary supply voltage	Nominal ±1%
• Auxiliary supply frequency	Nominal ±1%
• Auxiliary supply waveform (if AC)	Sinusoidal (distortion factor < 0·05)
• Magnetic field of external origin	Terrestrial flux

5.7 Environment

• Operating temperature	-25°C to +55°C*
• Storage temperature	-40°C to +70°C*
• Relative humidity	0 to 95%, non-condensing
• Altitude	Up to 3000m
• Warm up time	1 minute
• Vibration	10Hz to 50Hz, IEC 60068-2-6, 2g
• Shock	30g in 3 planes

*Maximum operating and storage temperatures are in the context of typical daily and seasonal variation.

5.8 Mechanics

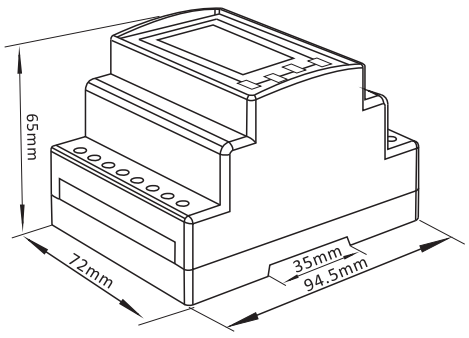
• DIN rail dimensions	72 x 94.5 mm (WxH) per DIN 43880
• Mounting	DIN rail (DIN 43880)
• Sealing	IP51 indoor
• Material	Self-extinguishing UL 94 V-0

5.9 Declaration of Conformity

We Smart Process & Control LTD.

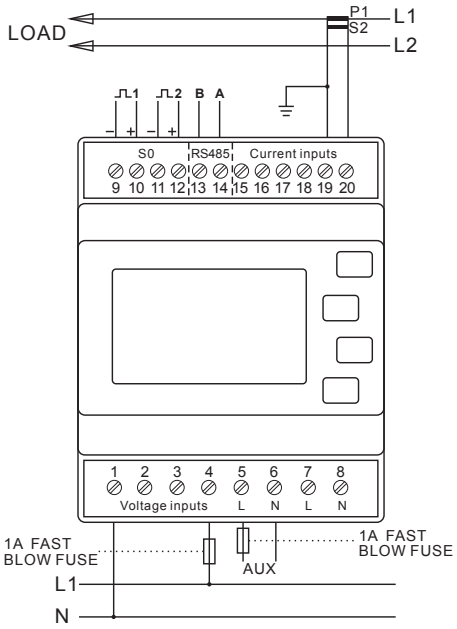
Declare under our sole responsibility as the manufacturer that the poly phase multifunction electrical energy meter “SMARTRAIL X835-MID” correspond to the production model described in the EC-type examination certificate and to the requirements of the Directive 2004/22/EC EC type examination certificate number 0120/SGS0150. Identifcation number of the NB 0120.

6 Dimensions

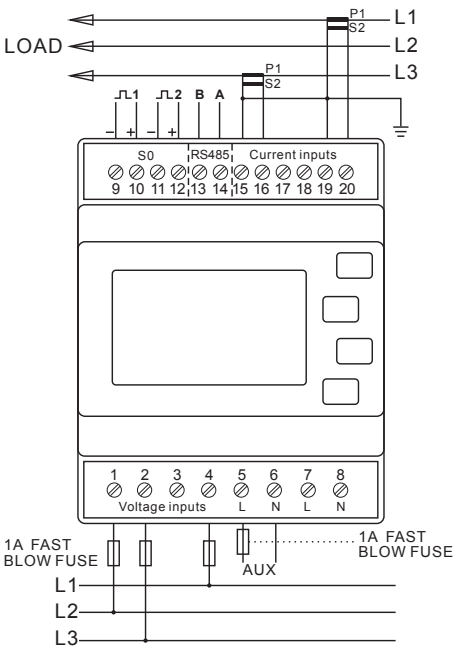


7 Installation

7.1 Single phase two wires



7.2 Three phase three wires



7.3 Three phase four wires